

# FAX

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Dear Miss Pothier

**Ref: 09/380,340**

I have sent through a copy of the amended sheet with all the amendments marked on them, I will do the same with the original copy when you send it through to me.

Hope the copy is in order.

Kind regards



Kelvin Doyle

Title of the Invention: Hinge Mechanism for a Limb Protector

1. The priority claim is of Patent Number PCT/GB98/00713, filing date.

2.

3. 03/05/98 Priority date 03/05/97

4.

5. Related Applications:

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7.

8. This invention relates to a hinge mechanism for a limb protector for the

9

10. joint of a human limb, that is a knee or elbow protector. Therefore it

11.

12. can have related application as a knee or elbow brace.<sup>[s]</sup>

13.

14.

15. Background to the Invention:

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17.

18. Injuries to the limbs and their joints occur for several reasons,

19.

20. including participation in contact sports such as American football

21.

22. ice hockey, in individual sports such as skiing or motorcycle

23.

24. racing or indeed any active sport. In addition injuries to limbs and

25.

26. their joints occur in active occupations such as armed forces, or in

27.

28. any type of accident.

29.

30.


31. After an injury occurs, it is often desirable to either slightly restrict the

32.

33. movement of the limb or the joint, for example by elastic support, or

34.

35. severely restrict movement of the limb or joint by ridged splints, or

36  
37     ridged braces that restrict the degree of movement of the limb or  
38  
39     joint, for example by hinged knee or elbow braces, (de-rotational  
40  
41     braces).  
42       
43     Such braces which are available to prevent twisting of a knee or  
44  
45     elbow can be worn during activities such as skiing and can have  
46  
47     preventative as well as protective effect. Such hinged braces are by  
48  
49     their very nature restrictive of movement and permit only forward  
50  
51     bending of the knee or elbow. Other braces are available for sports  
52  
53     such as American football which protects the knee against side  
54  
55     impact or frontal impact but also restrict movement (prophylactic or  
56  
57     preventative braces). Dynamic braces are also available with  
58  
59     eccentrically placed hinges to provide protection to torn ligaments.  
60  
61     The present invention relates to rigid hinged braces.

62  
63     Related art:

64  
65  
66     WO 94/18916 discloses a variety of hinged braces to be worn for the  
67  
68     protection or support of a damaged or potentially damageable joint.  
69  
70     The braces disclosed have, when applied to a knee joint,  
71  
72     respective upper and lower rigid supports which engage the leg above  
73  
74     and below the knee and which are hinged one to the other to allow  
75

76 bending of the joint. ↙

77

78 Because of the way the joint of the human knee is physically

79

80 constructed the bending of a joint can occur around any point within a

81

82 given area covering that joint when that joint is viewed from the

83

84 side, or in a direction substantially parallel to the axis of rotation of

85

86 the joint. ↙

87

88 The exact point about which the joint rotates is dependent upon the

89

90 construction of the joint, any injuries sustained by the joint or the limb

91

92 either side of the joint, or the amount by which the limb, and hence

93

94 the joint has already been bent. When for example the joint being

95

96 rotated is the knee, the points about which rotation may occur may be

97

98 either side of the cartilage that separates the tibia and fibula bones on

99

100 the one side, and the femur on the other side of the knee joint or on

101

102 both sides of the cartilage. Accordingly, to hinge the upper and

103

104 lower supports together about a simple pivot is unsatisfactory.

105

106 Instead, in preferred constructions as shown in Figures 5 and 16 of

107

108 WO 94/18916, each is pivoted to an intermediate member and the

109

110 two intermediate members are pivoted to one another. This allow

111

112 the axis of rotation to vary relative to the joints, e.g. When moving

113

114 from standing vertically to bending one's knees.

115 The constructions shown in W094/18916 are cumbersome, complex  
116  
117 to assemble, and require the manufacture of a plurality of telescopic  
118  
119 shells which must slide over one another easily, but which must be  
120  
121 sufficiently rigid and impact resistant (as such braces are often worn  
122  
123 during contact sport play to enable play to occur but reducing  
124  
125 the risk of further injury to a recovering limb) to ensure that such  
126  
127 movement can be maintained without jamming. These criteria are  
128  
129 not easy to meet.

130  
131 I have now found that a much more effective and robust hinging  
132  
133 mechanism can be provided which maintains the flexibility of  
134  
135 movement provided by the constructions shown in WO 94/18916,  
136  
137 but which does not incur its disadvantages. In particular, it may  
138  
139 enable easy assembly and disassembly and is very resistant to  
140  
141 mechanical damage.

142  
143  
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145  
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150  
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152  
153  
154

155 Brief Summary of the Invention:

156  
157 According to the present invention there is provided a hinge  
158  
159 mechanism for a limb protector including first and second supports  
160  
161 each adapted to engage a part of a limb in either side of an  
162  
163 articulated joint, the hinge mechanism being pivotally connected to  
164  
165 both supports, and wherein the hinge mechanism comprises a base  
166  
167 plate, an arm pivotally rotatable against the plate about an axis  
168  
169 substantially perpendicular thereto and located to one end of the arm  
170  
171 and means (by way of connecting screws) for connecting the support  
172  
173 members pivotally to the other end of the arm and to the plate, all of  
174  
175 these three axes of rotation of the pivotal connections being  
176  
177 substantially parallel, and wherein associated with each of the three  
178  
179 pivotal connections are means for restricting the relative degree of  
180  
181 rotation of the respective two members to a defined amount.  
182  
183 Preferably, the arm is mounted rotationally on a circular boss on the  
184  
185 plate and the plate has stop means formed thereon restricting the  
186  
187 angular rotation of the arm, e.g., to a maximum of 60 degrees.  
188  
189 Preferably, the angular rotation of each support member relative to  
190  
191 the end of the arm or the base plate respectively is restricted by the  
192  
193 passage of a stud or post along an arcuate slot centred on the pivot  
194

195 axis.

196

197 The post is conveniently on the base or arm and the arcuate slot in

198

199 the support member. The extent of the arcuate slot may vary, but is

200

201 commonly in the range of 50 degrees to 110 degrees.

202

203 By hinging of the supports together using a hinge mechanism

204

205 according to the present invention, with all three pivots having a

206

207 restricted degree of rotation, the degree of rotation of each of the first,

208

209 second and third pivotal connections may be set to predetermine the

210

211 maximum translational and rotational movement between the bones

212

213 of the joint around which the brace is to be fixed. This may be

214

215 achieved by providing slots of lengths corresponding to the maximum

216

217 likely desired degree of pivotal movement, e.g. 60 and 90

218

219 degrees and then limiting the degree of rotation of either or both

220

221 slots by inserting into the arcuate slot spacers or other means of

222

223 preventing rotation, so that the relevant studs or posts may move

224

225 only along a portion of that slot.

226

227 The degree of rotation available to the arm may be limited by locating

228

229 the arm in a recessed portion of the plate which is bounded by radial

230

231 walls e.g. inclined at 60 degree to one another. To limit the degree of

232

233 rotation further spacers or other means of preventing rotation may be

234

235 fixed within the recess. In place of a recess with walls, the amount of  
236  
237 rotation of the arm may be defined by studs mounted on the plate.  
238  
239 The hinge mechanism of the present invention may be made of any  
240  
241 suitable material, preferably aluminium alloy, though, if desired,  
242  
243 suitable engineering plastics materials may be used. The support  
244 [plastics or fibre reinforced resin type  
245 members are conventionally made of ridged material. In order to composition]  
246  
247 avoid over stressing such materials where they are connected to the  
248  
249 hinge mechanism, reinforcements, e.g. of metal, may be installed. In  
250  
251 particular, it is found useful to reinforce the edges of the arcuate slots  
252  
253 with a metal plate or liner.  
254  
255 In use, each limb protector or brace would have a hinge mechanism  
256  
257 according to the present invention on either side of the joint around  
258  
259 which the brace was placed.  
260  
261 The hinge of the present invention may be employed on all currently  
262  
263 known types of kneebrace once suitable modification has been made  
264  
265 to those knee braces. In particular, the present invention is of value  
266  
267 applied to braces as described in WO 94/18916, with the arrangement  
268  
269 as described above replacing the front plates of the hinged brace  
270  
271 described therein.  
272  
273  
274



275 BRIEF DESCRIPTION OF DRAWING

276  
277 The invention is illustrated by way of example with reference to the  
278  
279 accompanying drawings in which:

280  
281 Figure 1 shows a perspective view of the knee brace incorporating a  
282  
283 hinge mechanism according to the present invention, and  
284  
285 Figure 2 shows a detail of the brace of Figure 1 in exploded view.

286

287

288 DETAILED DESCRIPTION OF INVENTION

289

290 Referring to Figure 1, the knee brace which is illustrated lying on its  
291

292 side and from the back as shown in the drawings, consist basically of

293

294 upper and lower hollow shell or supports members 1 and 2 are

295

296 respectively shaped to accommodate the thigh and calf of the

297

298 wearer. Members 1 and 2 are joined by hinge mechanism 3 and

299

300 4, described in more detail below, and may be held on the

301

302 respective parts of the legs by means of hard

303

304 moulded semi- cylindrical portions 5 and 6. Projecting from the ends

305

306 of portions 5 and 6 are locating tabs and straps which fit into

307

308 corresponding apertures in members 1 and 2 via appropriate snap

309

310 action catches enabling each to be pushed towards the member 1

311

312 and 2 respectively to fit snugly around the thigh or calf respectively.

313

314

315 Substantially the whole of the interior of members 1 and 2, 5 and 6 is  
316  
317 lined with a cushioning foam for comfort. Fitted to the interior of  
318  
319 each of the members 1 and 2 are some short metal rods which are  
320  
321 substantially vertical when the brace is worn with the wearer standing  
322  
323 upright. These are obscured in the drawing by double-sided burr  
324  
325 fastener straps 10, 11, 12 and 13. Straps 12 and 13 are relatively short  
326  
327 and one end of each terminates in an elongate plastics ring 15 and 16  
328  
329 respectively through which the free end of the rather longer straps 10  
330  
331 and 11 may be passed and then folded back on itself to tension each  
332  
333 strap round the rear of the lower thigh and upper calf respectively.  
334  
335 The central portions of the longer strap 10 and 11 may be fabrics  
336  
337 faced than faced with burr fastener material, for greater comfort.  
338  
339 Hollow shell member 2 is constructed in two parts, the left hand one  
340  
341 of which as shown in the drawing has an annular outward facing  
342  
343 groove 20 and the other portion of which to the right in Figure 1  
344  
345 has an annular inward facing rib 21. Rib 21 can slide in the annular  
346  
347 grove to a certain extent, thus allowing a limited degree of  
348  
349 swivelling between the portion of the brace which is attached to  
350  
351 the thigh and the portion which is attached to the calf. This  
352  
353 swivel feature is described in more detail in Specification  
354

355 WO94/18916. The right hand portion of member 2 is held  
356  
357 captive in the left hand portion by means of a pair of squat T-section  
358  
359 bosses which pass through two short slots 25 and 26 located in the  
360  
361 base of groove 20.

362  
363 In accordance with the invention, members 1 and 2 are held together  
364  
365 by two hinged mechanisms 3 and 4. Each of hinge mechanism 3  
366  
367 and 4 consists of a base plate 40, 41 respectively which is  
368  
369 pivotally attached directly to member 1 and which has mounted  
370  
371 on it a swivellable arm to the free end of which is pivotally  
372  
373 attached member 2.

374  
375  
376 The detailed construction of the hinge mechanism 4 is shown in  
377  
378 Figure 2. The construction of hinge mechanism 3 is identical  
379  
380 save for being a mirror image of hinge mechanism 4. Referring  
381  
382 now to Figure 2, this shows an exploded view of the hinge  
383  
384 mechanism with the two members 1 and 2 detached from the  
385  
386 base plate 41 and the arm contained therein, for clarity of  
387  
388 explanation.

389  
390 Base plate 41 has two threaded bosses on its surface facing hinge  
391  
392 mechanism 3. One of these, denoted 50 in Figure 2, acts as the  
393  
394 pivotal connection between base plate 41 and member 1 and

395  
396 pivots about an axis substantially perpendicular to the base plate 41.  
397  
398 For this purpose, a lockable threaded stud 51 may be passed  
399  
400 through an aperture 52 in member 1 and screwed into boss 50 which  
401  
402 is internally threaded.  
403  
404 As that occurs, an upstanding arcuate tab 54 enters in to an arcuate  
405  
406 slot 55 in the material of member 1, slot 55 being centred on  
407  
408 aperture 52. Not shown in the drawing is a metal reinforcement  
409  
410 which is moulded into the exterior of member 1 and which has  
411  
412 an aperture registered with aperture 52 and arcuate slot registered  
413  
414 with arcuate slot 55. When member 1 is accordingly assembled on to  
415  
416 base plate 41, it can pivot relative thereto, but only to the extent  
417  
418 allowed by the travel of tab 54 in slot 55.  
419  
420 If it is desired to restrict the range of rotation of member 1 relative to  
421  
422 base plate 41, a suitable stop member may be inserted at one or both  
423  
424 ends of slot 55.  
425  
426 Mounted on base plate 41 is a swivel arm 60. The left hand end of  
427  
428 this arm as seen in Figure 2 is of ring shape and fitted round a further  
429  
430 threaded post formed integrally with base plate 41 and held in place  
431  
432 by a screw-in stud 61. The circular left hand end of arm 60 is  
433  
434 located in a generally circular recess 62 in base the plate 41.

435  
436 This recess is a continuation of the internal wall 68 and is formed  
437  
438 from two radial sections, one 80 having a radius only slightly greater  
439  
440 than the radius of the ring on the left hand arm of arm 60 and the  
441  
442 other 90 having an enlarged radius forming the two part cylindrical  
443  
444 wall of recess 62 abutting at a shoulder 64 which lies in a radial plane  
445  
446 relative to the hidden threaded stud about which arm 60 may swivel.  
447  
448 On one side of the generally ring-shaped end of arm 60 is a partial  
449  
450 annular flange 66 which, when its end as shown on the left in  
451  
452 Figure 2 abuts shoulders 64, limits the clockwise rotation of arm  
453  
454 60. The anti-clockwise rotation is limited by the right hand end of  
455  
456 arm 60 as shown in Figure 2 coming to abut an internal wall 68  
457  
458 formed in base member 41. Thus, arm 60 may swivel through a  
459  
460 defined angle, which may be reduced by inserting packing  
461  
462 members against shoulder 64 or wall 68 if it is desired to do so. It  
463  
464 can be also be seen that the radial sections 80, 90 which are part of  
465  
466 wall 68 are lined at an angle to one another.  
467  
468 Member 2 is pivotally connected to the right hand end of arm 60  
469  
470 about an axis substantially perpendicular to the base plate by  
471  
472 means of a threaded stud 70 which passes through an aperture 71 in  
473  
474 member 2 and into a threaded post 72 on the end of arm 60. Arm 60

475  
476 is formed with an upstanding tab 74 or post which, when member 2 is  
477  
478 assembled on to the arm 60, passes through an arcuate slot 76 in  
479  
480 member 2.

481  
482 Again, the extent of rotation permitted between arm 60 and member 2  
483  
484 may be reduced by inserting stop members into one or both ends of  
485  
486 arcuate slot 76.

487  
488 The outer periphery of base plate 41 may be contoured so that its  
489  
490 inner face lies closely against the exterior faces of members 1  
491  
492 and 2 thus reducing the ingress of dirt or other contamination when  
493  
494 the knee brace is worn. The hinge mechanism 3 and 4 permit natural  
495  
496 flexure of the wearer's leg with the three pivotal connections, the  
497  
498 pivot axes of which correspond to the threaded shafts of studs 51,  
499  
500 61 and 70, enabling a natural and comfortable movement to  
501  
502 occur. Excessive flexure of the joint, beyond what the wearer's  
503  
504 medical or physiotherapist advisors would recommend, may be  
505  
506 prevented by restricting the range of angular movement of one,  
507  
508 two or all three of these pivotal connections by the use of  
509  
510 packing members as indicated above. The support members are  
511  
512 made from rigid plastic or fibre reinforced resin type composition.